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## (54) PRODUCTION OF FRICTION MATERIAL, AND FRICTION MATERIAL PRODUCED THEREBY

### (57)Abstract:

**PURPOSE:** To produce a friction material having a high burst strength and stable friction characteristics even at a high temp. under a high load.

**CONSTITUTION:** A friction material is produced by coating or impregnating a fibrous substrate sheet with a mixture comprising a binder and a friction- controlling agent, drying the sheet and then winding it up into the form of a ring or winding it up in the same way before drying to give a premolded article having an apparent density of at least a half of the true density of the dried sheet, and molding and thermally treating the article.

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(54)【発明の名称】摩擦材の製造法及び該製造法で製造した摩擦材

(57)【要約】

【目的】高温高負荷の条件下でも高いバースト強度及び安定した摩擦特性を有する摩擦材の製造法及び該製造法で製造した摩擦材を提供する。

【構成】纖維状物質の基材、摩擦調整剤及び結合剤からなる摩擦材を製造する方法において、シート状の纖維基材に摩擦調整剤と結合剤とを混合した混和物を塗布又は含浸後、該シート状の纖維基材を乾燥して環状に巻き上げるか又は環状に巻き上げてから乾燥して、シート状の纖維基材(乾燥品)の真密度の0.5倍以上の見掛け密度を有する予備成形品を得、次いでこれを成形及び熱処理する摩擦材の製造法及び該製造法で製造した摩擦材。

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## 【特許請求の範囲】

【請求項1】 繊維状物質の基材、摩擦調整剤及び結合剤からなる摩擦材を製造する方法において、シート状の繊維基材に摩擦調整剤と結合剤とを混合した混和物を塗布又は含浸後、該シート状の繊維基材を乾燥して環状に巻き上げるか又は環状に巻き上げてから乾燥して、シート状の繊維基材(乾燥品)の真密度の0.5倍以上の見掛け密度を有する予備成形品を得、次いでこれを成形及び熱処理することを特徴とする摩擦材の製造法。

【請求項2】 繊維基材がガラスマットを含む請求項1記載の摩擦材の製造法。

【請求項3】 請求項1又は2に記載の摩擦材の製造法により製造した摩擦材。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】 本発明は、自動車の動力伝達、制動等に用いられる摩擦材の製造法及び該製造法で製造した摩擦材に関する。

## 【0002】

【従来の技術】 自動車に用いる摩擦材としては、一般にブレーキライニング、ディスクパッド及びクラッチフェーシングがある。これらは従来、石綿(アスベスト)を基材として使用していたが、アスベスト公告の問題から非アスベスト系摩擦材の開発が望まれている。また、自動車エンジンの性能向上に伴い摩擦材の摩擦特性(摩擦係数、摩耗率)、機械特性の向上が望まれている。更に最近は使用条件が苛酷になり高温時の高速回転強度も要求されるようになってきている。現在、石綿基材の代替材として、ガラス繊維、炭素繊維、芳香族ポリアミド繊維、ロックウール、セラミック繊維、各種のスチールファイバー等を使用した摩擦材が開発され、一部で使用されている。しかし、これらの基材は従来の石綿に比べて高弾性で硬く、耐熱性が低いために、摩擦材にした場合に種々の問題があり、上記した要求される性能を満足しない。

## 【0003】

【発明が解決しようとする課題】 石綿代替材を使用し、高温で高負荷に耐える摩擦材としては、あらかじめ摩擦材自身を高温処理したもの(例えば、特開昭56-131846号公報、59-113038号公報、60-145302号公報等)があるが、これはコスト高や機械強度の低下を伴う。特殊な摩擦調整剤を添加したもの(例えば特開昭60-96625号公報、60-92332号公報、62-190232号公報等)もあるが、従来の結合剤では耐熱性と接着性が不足しているため、その効果を十分発揮できない。また基材に耐熱性の高いアラミド繊維やポリイミド樹脂粉を加えたものなどが開示されているが、基材及び摩擦調整剤を保持する結合剤の耐熱性が充分でなく高温強度が得られない。たとえ耐熱性樹脂を結合剤として使用し摩擦材を得ようととしても、従来の製造方法では工業的、技術的に困難である。

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る。

【0004】 更に、摩擦特性を改善するために摩擦調整剤添加量に自由度がもてるモールド成形法で製造した摩擦材もあるが、繊維状物質として短纖維を用いるため機械強度に難点があり製品化はごく一部に限られている。この方法で長纖維を用いた場合は、成形品密度を均一にすることが困難であり、このばらつきにより機械強度の低下が著しい。以上のことから、摩擦特性と機械強度を向上させるためには一般に摩擦メンバーと強度メンバーに分けて、強度保持のためには現状のクラッチフェーシングの裏面に薄い鋼板又はアルミニウム板等を貼り合せる手法を採用している(特開平2-163529号公報、特開昭62-266239号公報、特開昭61-41022号公報又は、特開平1-141242号公報)。その他、塗工組の巻きパターンやヤーンに改善を加えたものがあるが、工業化において技術的に困難である(例、特開昭62-141328号公報、特開昭62-215134号公報又は特開昭62-266237号公報)。

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【0005】 本発明に關係の深い特許出願に特開昭55-86820号公報、特開昭63-56534号公報、特開昭63-140133号公報及び特開昭63-251432号公報がある。特開昭55-86820号公報のものは、基材のガラス繊維がフィラメントであり、目付が $1000\text{ g/m}^2$ 、厚さが $2\sim 3\text{ mm}$ と厚く、また目が詰んでいるために、結合剤中に含まれる摩擦調整剤の粒状物が基材の内部にまで浸透せず、摩擦係数が不安定になり易い。また、比較的多量の摩擦調整剤を加えると、基材と摩擦調整剤との層ができ、その層間強度が低下することからバースト強度も低下する。特開昭63-56534号公報のものは、ガラス繊維が $2\sim 20\text{ mm}$ と長く、目付も $100\text{ g/m}^2$ 付近で良好であるが、フィラメントを用いているために不織布の目が詰まり、粒状物を含む混合物が基材の内部にまで含浸し難い。強制的に含浸するとランダムに配置した繊維が樹脂の流動方向を向いて等方性が欠け、強度の低下や反りを生ずる。特開昭63-140133号公報では、チョップドストランドを使用し、モールド成形によりブレーキ用摩擦材を製造している。しかし、モールド成形によって製造したクラッチフェーシングはバースト強度が低く、高出力車には適用できない。特開昭63-251432号公報のものは、基材繊維が不織布であり、結合剤中に含まれる摩擦調整剤の粒状物が基材の内部にまで浸透しないため不均一な構造となり、バースト強度の向上及び反りの改善は望めない。

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【0006】 本発明は、上記した問題を解消し、高温高負荷の条件下でも高いバースト強度及び安定した摩擦特性を有する摩擦材の製造法及び該製造法で製造した摩擦材を提供することを目的とする。

## 【0007】

【課題を解決するための手段】 本発明は、繊維状物質の基材、摩擦調整剤及び結合剤からなる摩擦材を製造する

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方法において、シート状の繊維基材に摩擦調整剤と結合剤とを混合した混和物を塗布又は含浸後、該シート状の繊維基材を乾燥して環状に巻き上げるか又は環状に巻き上げてから乾燥して、シート状の繊維基材（乾燥品）の真密度の0.5倍以上の見掛密度を有する予備成形品を得、次いでこれを成形及び熱処理する摩擦材の製造法及び該製造法で製造した摩擦材に関する。

【0008】本発明において繊維状物質の基材の材質としては、ガラス繊維、炭素繊維、ロックウール、セラミック繊維等の無機繊維、鉄線等の金属線、フェノール樹脂繊維、芳香族ポリアミド樹脂繊維等の有機繊維などであり、特に制限はないが、加工の容易なこと、安価なことなどからガラス繊維が好ましい。シート状の繊維基材の形態としては、マット、フェルト等の不織布のほか、抄造シート、撚糸ヤーン、織布等があるが、結合剤の含浸性、結合剤及び摩擦調整剤の分散した構造の均一性、価格等からマットが好ましい。また、例えばガラス繊維のマットに短繊維及び金属線等を加えてよい。また、ここで使用されるシートの厚さに制限はないが、複数枚を積層して強度を向上させる。

【0009】不織布のガラスマットを用いる場合は、そのマットはショップドストランドから得られたものであり、ストランドは50～200本のフィラメントの集合体から形成され、ストランドの長さが20～100mmで、目付が150～800g/m<sup>2</sup>のものが、強度及びかさ密度が高く、構造が均一で、摩擦特性が良く、好ましい。フィラメント数を80～150本、ストランド長さ25～80mm、目付300～500g/m<sup>2</sup>にすれば更に好ましい。ガラスマットを構成するストランドの結束剤は、通常の有機溶媒に溶解しないポリビニルアルコールが好ましく用いられる。結合剤のガラスマットへの付着量は、ガラスマットに対して重量で1～15%が好ましく、3～10%であれば更に好ましい。付着量が少ないとガラスマットを形成するストランドの接着性と嵩高さが保持できない。また付着量が多いとガラスマットが剛直化し、後の加工に支障を生ずる。ガラスマットの量は摩擦材中に25～60重量%含有させるのが好ましい。ガラス繊維の量が少ないと相対的に摩擦調整剤の無機粉の量が多くなり、摩擦特性のバランスをとりにくい。一方ガラス繊維の量が多いと摩擦調整剤の量が少なくなり、摩擦特性の制御が困難となる。より好ましい値は30～50重量%である。

【0010】摩擦調整剤は、メラミン樹脂硬化物、三酸化アンチモン（Sb<sub>2</sub>O<sub>3</sub>）及び銅粉を含むものが良好な摩擦特性を保持するために好ましい。メラミン樹脂硬化物としては、メチル化メラミン樹脂、ベンゾグアナミン樹脂及びメチルグアナミン樹脂の各硬化物、これらのエーテル化メラミン樹脂硬化物等が使用されるが、好ましくはメチル化メラミン樹脂の硬化物であり、粉末にして用いる。硬化条件及び粉末粒度は特に制限がない。メラ

ミン樹脂硬化物粉末（メラミンダストと呼ぶ）の量は得られる摩擦材中に5～30重量%含有させるのが好ましい。量が少ないと安定した摩擦係数が得られず、量が多すぎると摩耗率が大きくなる。また量が多すぎても少なすぎても摩擦係数と耐摩耗率とのバランスがとり難い。より好ましくは5～25重量%である。三酸化アンチモンもメラミンダストと同様の作用を有し、摩擦材中に3～10重量%含有させるのが好ましい。含有量が少ないと摩擦係数を安定させる効果がなく、多過ぎると効果が向上せず、密度を大きくする。銅粉は結合剤の高温フェードを防止するのに有効である。銅粉は形状が鱗片状（箔状）、粒状及び短繊維状に大別され、特に制限はないが、均一に分散され易い点で箔状又は粒状（電解銅粉を含む）が好ましい。粒度は特に制限しない。銅粉の量は結合剤の固形分に対して1～40重量%が好ましい。銅粉の量が少ないと高温でのフェード現象の防止が困難となり、多すぎると摩擦係数が大きく不安定で摩耗率も高くなる。より好ましくは5～30重量%である。

【0011】摩擦調整剤はこのほか、公知の炭酸カルシウム、炭酸マグネシウム、硫酸バリウム、クレー、タルク、黒鉛、アルミニウム、マイカ、萤石、ジルコニア、ヘマタイト、マグнетライト、シリカ、硫化アンチモン、硫化鉄、硫化モリブデン等の無機物の粉末、鉄、鉛等の金属の粉末、カシューダスト、ゴムダスト、各種樹脂硬化物の粉末等の有機物の粉末などが使用される。

【0012】結合剤はフェノール樹脂が好ましく用いられる。その理由は耐熱性及び接着性に優れ、安価な上に摩擦調整剤のメラミンダスト、三酸化アンチモン、銅粉等と組合せることにより、他の熱硬化性樹脂を使用した場合よりも摩擦特性の温度依存性を小さくできるからである。フェノール樹脂の中では未変性でかつレゾール型のものがより好ましい。またフェノール樹脂と共に耐熱性に影響しない程度にメラミン樹脂、尿素樹脂、ポリアミドイミド樹脂、ポリイミド樹脂、エポキシ樹脂等の熱硬化性樹脂又は架橋性ゴムを用いてもよい。結合剤の量は得られる摩擦材中に固形分として10～50重量%含有させるのが好ましい。結合剤の量が少ないと繊維状物質の基材と摩擦調整剤との結合力が弱くなる。多すぎると摩擦係数及び摩耗率の調整が困難になる。

【0013】摩擦材を得るには次のような方法による。まず熱硬化性樹脂の溶液に摩擦調整剤を加えて混合した混和物をガラスマットのようなシート状の繊維基材に塗布又は含浸して、繊維基材に混和物を均一に付着させて塗工シートとし、この塗工シートを環状に巻き上げた後乾燥等により溶媒を除去して予備成形品を得るか、又は塗工したシートを乾燥機等で乾燥して溶媒を除去したプリプレグシートとした後、このシートをロール状、スリット状等のテープに切断して環状に巻き上げ予備成形品を得る。この予備成形品の見掛け密度がプリプレグシートのようなシート状の繊維基材の真密度（乾燥品ベース）

の0.5倍未満では、成形品の押し代が大きすぎて環状に巻き上げたシートが乱れるために、バースト強度が低下する。予備成形品の見掛け密度をシート状の繊維基材の真密度の0.5倍以上にするためには、塗工シート又はプリプレグシートを環状に巻き付ける際に、3本縫め付けロール、面圧ロール等を用いて引っ張り力を加えながら巻き付ける等の方法がある。このようにして得られた環状体を金型等に入れて熱圧成形を行い、次いで成形品を所定の加熱条件下で熟処理して樹脂を硬化させる。

【0014】繊維基材にガラスマットを用いた場合の混和物の付着量は、重量でガラスマット／混和物（摩擦調整剤+結合剤の固形分）が35/65～65/35が好ましい。混和物の付着量が多くすると機械強度が低下し、摩耗が増大する。一方、付着量が少ないと摩擦係数が高くなり、不安定になる。混和物を付着させる塗布又は含浸の方法に制限はないが、繊維基材を混和物中に浸漬含浸するか、又はナイフコータで塗布する方法が付着量が均一で好ましい。溶媒を除去する方法も特に制限はなく、付着した樹脂が硬化しないようにする。

## 【0015】

【実施例】次に本発明の実施例を説明する。

## 【0016】実施例1

摩擦調整剤としてメラミン樹脂硬化物の粉末（カシュー（株）製、メラミンダストH-9044）8重量部、三酸化アンチモン（和光純薬工業製、化学用）6重量部、電解銅粉（日本鉛業製、N0.5-2-D、 $4.4\mu m$ 以下）2重量部、硫酸バリウム（堺化学製、BC）3重量部、珪酸カルシウム短纖維（米国NYCO社製、商品名ウォラストナイト）3重量部、カシュー変性フリクションダスト（カシュー（株）製、WD-1350）1重量部及びカーボンブラック（東海カーボン製、シースト116）2重量部の計25重量部を用意した。更にゴム加硫剤として硫黄粉（細井化学製、微粉硫黄）3重量部及び酸化亜鉛（和光純薬工業製、化学用）0.6重量部の計3.6重量部を用意し、前記摩擦調整剤と共にV型混合機で混合して混合粉を作成した。

【0017】一方、レゾール型フェノール樹脂（大日本インキ化学工業製、TD-2040C、固形分100%）15重量部及びアクリルニトリルブタジエゴム（NBR、日本ゼオン製、Nippol 1041）6.4重量部に対し、MEK（メチルエチルケトン）61重量部を加えて混合溶解し、フェノール樹脂/NBR溶液を作成した。この溶液に前記混合粉を投入混合して混和物（スラリー）を得た。

【0018】幅30cm×長さ60mのガラスマット（富士ファイバーグラス製、FEM450-5（フィラメント数100本、ストランド長さ50.8mmのトップドストランドから得られたもの、目付は450g/m<sup>2</sup>）の50重量部に、ポリビニルアルコール（和光

純薬工業製：重合度400、以下PVAと呼称）の5重量%水溶液を含浸してPVAを付着させた。この含浸処理ガラスマットを前記スラリー中に浸漬して含浸シートとし、これを連続乾燥機で60℃の温度で乾燥して真密度2.27g/cm<sup>3</sup>のプリプレグシートの成形用シートとした。次にこの成形用シートを10mm幅のテープ状に切断し、その長さ約30mを内径150mmの鉄製円柱に巻きつけて外径225mm、厚さ10mmの円環状の予備成形品を得た。このものの密度は1.14g/cm<sup>3</sup>（プリプレグシートの真密度の0.5倍）であった。次いでこの予備成形品を円柱ごと金型に充填し、100kgf/cm<sup>2</sup>の圧力で160℃で15分間成形し、厚さ4.5mmの成形体を得た。この成形体の両面をサンダーで研磨して厚さ3.5mmとした後、180℃で1時間、210℃で2時間、240℃で2時間の順に後硬化を行い、密度が1.55g/cm<sup>3</sup>の摩擦材を得た。

## 【0019】実施例2、3、4及び5

実施例1と同様の方法で、密度(g/cm<sup>3</sup>)が1.36、1.48、1.65及び2.00（プリプレグシートの真密度の0.6倍、0.65倍、0.73倍及び0.88倍）の予備成形品を得、以下、実施例1と同様の方法で熱圧成形、研磨及び後硬化を行い、密度(g/cm<sup>3</sup>)が1.55、1.60、1.68及び2.05の摩擦材を得た。

## 【0020】比較例1、2及び3

実施例1と同様の方法で密度(g/cm<sup>3</sup>)が0.68、0.79及び1.02（プリプレグシートの真密度の0.30倍、0.35倍及び0.45倍）の予備成形品を得、以下、実施例1と同様の方法により密度(g/cm<sup>3</sup>)が1.55、1.55及び1.56の摩擦材を得た。

## 【0021】比較例4

実施例1における円柱に巻きつけるテープ状シートの幅を8mmにした以外は実施例1と全く同様にして、密度0.68g/cm<sup>3</sup>（プリプレグシートの真密度の0.30倍）の予備成形品を得、以下実施例1と同様の方法により、密度が1.2g/cm<sup>3</sup>の摩擦材を得た。

【0022】実施例及び比較例で得られた摩擦材の円環の一部を切りだして試験片とし、この試験片をJIS D4411に定める定速度摩耗試験機に取付けて運転し、押付け圧力5kgf/cm<sup>2</sup>で300℃における摩耗率を測定した。また、円環状の摩擦材を回転破壊強度試験機に取付け、雰囲気温度200℃で5分間2500rpmで回転し、次いで毎秒100回転の速度で回転数を上昇させ、破壊時の回転数を測定してバースト強度とした。これらの試験結果を表1に示す。表1において摩耗率は表中の数値に10<sup>-6</sup>を掛けた値(cm<sup>3</sup>/kgf·m)である。

## 【0023】

【表1】

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表 1

実施例	摩耗率	バースト強度	比較例	摩耗率	バースト強度
1	2.0	13800	1	8.8	9800
2	2.0	14000	2	7.0	10000
3	1.5	14400	3	6.0	11800
4	1.3	14200	4	6.0	8700
5	1.0	14000			

【0024】表1から明らかなように、実施例の摩擦材

は比較例のものに比べてバースト強度が大きく、かつ摩耗率が小さいことが示される。

【0025】

10 【発明の効果】本発明によれば、特に高温でのバースト強度が高く、摩耗率の低い摩擦材が提供できる。

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## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the friction material manufactured by the manufacturing method and this manufacturing method of the friction material used for power transfer of an automobile, braking, etc.

[0002]

[Description of the Prior Art] Generally as friction material used for an automobile, brake lining, a disk pad, and clutch facing occur. Although these were using asbestos (asbestos) as a base material conventionally, development of non-asbestos system friction material is desired from the problem of an asbestos public nuisance. Moreover, improvement in the friction property (coefficient of friction, wear rate) of friction material and a mechanical characteristic is desired with the improvement in the engine performance of an automobile engine. Furthermore, a service condition becomes cruel and the high-speed drum strength at the time of an elevated temperature is also required increasingly recently. The friction material which used a glass fiber, a carbon fiber, aromatic polyamide fiber, rock wool, ceramic fiber, various kinds of steel fibers, etc. is developed as an alternate material of current and an asbestos base material, and it is used partly. However, these base materials are hard at high elasticity compared with conventional asbestos, since thermal resistance is low, when it is made friction material, there are various problems, and the above-mentioned engine performance demanded is not satisfied.

[0003]

[Problem(s) to be Solved by the Invention] An asbestos alternate material is used, and although there are things (for example, JP,56-131846,A, a No. 113038 [ 59 to ] official report, a No. 145302 [ 60 to ] official report, etc.) which carried out high temperature processing of the friction material itself beforehand as friction material which bears a heavy load at an elevated temperature, this is accompanied by the fall of cost quantity or mechanical strength. Although there are also things (for example, JP,60-96625,A, a No. 92332 [ 60 to ] official report, a No. 190232 [ 62 to ] official report, etc.) which added the special friction regulator, since thermal resistance and adhesive properties are insufficient, with the conventional binder, the effectiveness cannot be demonstrated enough. Moreover, although what added a heat-resistant high aramid fiber and polyimide resin powder to the base material is indicated, the thermal resistance of the binder holding a base material and a friction regulator is not enough, and high temperature strength is not obtained. Even if it is going to obtain friction material as a binder using heat resistant resin, by the conventional manufacture approach, it will be technically [ industrially and ] difficult.

[0004] Furthermore, in order to improve a friction property, there is also friction material manufactured by the mold fabricating method which can have a degree of freedom in a friction regulator addition, but in order to use a staple fiber as a fibrous material, a difficulty is in mechanical strength and commercial production is restricted very much to the part. When

continuous glass fiber is used by this approach, it is difficult to make a mold-goods consistency into homogeneity, and the fall of mechanical strength is remarkable by this dispersion. From the above thing, in order to raise a friction property and mechanical strength, generally it divided into the friction member and the member on the strength, and for maintenance on the strength, the technique of sticking a thin steel plate or a thin aluminum plate etc. on the rear face of the present clutch facing is adopted (JP,2-163529,A, JP,62-266239,A, JP,61-41022,A, or JP,1-141242,A). In addition, although there are some which added the improvement to a coating string's volume pattern and yarn, in industrialization, it is technically difficult (an example, JP,62-141328,A, JP,62-215134,A, or JP,62-266237,A).

[0005] JP,55-86820,A, JP,63-56534,A, JP,63-140133,A, and JP,63-251432,A are in this invention at closely related patent application. The granular object of the friction regulator with which the thing of JP,55-86820,A is contained in a binder since the glass fiber of a base material is a filament, and 1000 g/m<sup>2</sup> and thickness of eyes are as thick as 2-3mm and the eye is checkmated does not permeate even the interior of a base material, but coefficient of friction tends to become unstable. Moreover, if comparatively a lot of friction regulators are added, the layer of a base material and a friction regulator is made, and since the reinforcement between the layer falls, burst reinforcement will also fall. Although the thing of JP,63-56534,A has a glass fiber as long as 2-20mm and eyes are [ the 100 g/m<sup>2</sup> neighborhood ] also good, since the filament is used, the eye of a nonwoven fabric is got blocked, and mixture containing a granular object cannot sink even into the interior of a base material easily. If it sinks in compulsorily, the fiber arranged at random will turn to the flow direction of resin, isotropy will be missing, and a strong fall and strong curvature will be produced. In JP,63-140133,A, a chopped strand is used and the friction material for brakes is manufactured with mold shaping. However, clutch facing manufactured with mold shaping has low burst reinforcement, and it cannot apply it to a high power vehicle. Since the granular object of the friction regulator which base material fiber is a nonwoven fabric and is contained in a binder does not permeate even the interior of a base material, the thing of JP,63-251432,A serves as uneven structure, and the improvement in burst reinforcement and an improvement of curvature cannot be desired.

[0006] This invention solves the above-mentioned problem and aims at offering the friction material manufactured by the manufacturing method and this manufacturing method of the friction material which has high burst reinforcement and the stable friction property also under the conditions of an elevated-temperature heavy load.

[0007]

[Means for Solving the Problem] In the approach of manufacturing the friction material which this invention becomes from the base material, friction regulator, and binder of fibrous material It dries, after drying the fiber base material of this shape after spreading or sinking in and of a sheet to a sheet-like fiber base material, and winding up annularly the admixture which mixed the friction regulator and the binder to it or winding up to annular. The preforming article which has the apparent density of 0.5 times or more of the true density of a sheet-like fiber base material (desiccation article) is obtained, and it is related with the friction material manufactured by the manufacturing method and this manufacturing method of friction material which subsequently fabricate and heat-treat this.

[0008] Although it is organic fiber, such as metal wires, such as inorganic fibers, such as a glass fiber, a carbon fiber, rock wool, and ceramic fiber, and a low carbon steel wire, phenol resin fiber, and aromatic polyamide resin fiber, etc. as the quality of the material of the base material of fibrous material in this invention and there is especially no limit, the easy thing of processing, and since it is cheap, a glass fiber is desirable. As a gestalt of a sheet-like fiber base material, although there are a paper-milling sheet besides non-woven fabrics, such as a mat and felt, throwing yarn, textile fabrics, etc., the homogeneity of the structure which the impregnating ability of a binder, the binder, and the friction regulator distributed, a price, etc. to a mat is desirable. Moreover, a staple fiber, a metal wire, etc. may be added, for example to the mat of a

glass fiber. Moreover, although there is no limit in the thickness of the sheet used here, the laminating of two or more sheets is carried out, and reinforcement is raised.

[0009] When using the fiberglass mat of a non-woven fabric, the mat is obtained from a chopped strand, it is formed from the aggregate of 50-200 filaments, and the die length of a strand is 20-100mm, and it is [ reinforcement and bulk density of eyes are / the thing of 150 - 800 g/m<sup>2</sup> / high, and structure is uniform, and / the friction property of a strand is good and ] desirable [ a strand ]. It is still more desirable if the number of filaments is set to 80-150, strand die length of 25-80mm, Eyes 300-500g/m<sup>2</sup>. The polyvinyl alcohol which does not dissolve the union agent of the strand which constitutes a fiberglass mat in the usual organic solvent is used preferably. The coating weight to the fiberglass mat of a union agent is desirable by weight to a fiberglass mat, and if it is 3 - 10%, it is still more desirable. [ 1 - 15% of ] If there is little coating weight, the adhesive property of a strand and dimension height which form a fiberglass mat cannot be held. Moreover, if there is much coating weight, a fiberglass mat will make it upright and will produce trouble in next processing. As for the amount of a fiberglass mat, it is desirable to make it contain 25 to 60% of the weight in friction material. If there are few amounts of a glass fiber, the amount of the inorganic powder of a friction regulator will increase relatively, and it will be hard to balance a friction property. On the other hand, if there are many amounts of a glass fiber, the amount of a friction regulator will decrease and control of a friction property will become difficult. A more desirable value is 30 - 50 % of the weight.

[0010] A friction regulator is desirable in order that the thing containing a melamine resin hardened material, an antimony trioxide (Sb 2O<sub>3</sub>), and copper powder may hold a good friction property. As a melamine resin hardened material, although each hardened materials of methylation melamine resin, benzoguanamine resin, and methyl guanamine resin, these etherification melamine resin hardened materials, etc. are used, it is the hardened material of methylation melamine resin preferably, and uses by making it powder. Hardening conditions and especially powder grain size do not have a limit. As for the amount of melamine resin hardened material powder (it is called melamine dust), it is desirable to make it contain five to 30% of the weight in the friction material obtained. Coefficient of friction stabilized when there were few amounts is not obtained, but a wear rate will become large if there are too many amounts. Moreover, even if there are too many amounts and it is too few, it is hard to balance coefficient of friction and the rate of antifriction. It is 5 - 25 % of the weight more preferably. It is desirable for an antimony trioxide to also have the same operation as melamine dust, and to make it contain it three to 10% of the weight in friction material. When there are few contents, there is no effectiveness of stabilizing coefficient of friction, if many [ too ], effectiveness will not improve but a consistency will be enlarged. Copper powder is effective in preventing the elevated-temperature fade of a binder. copper powder — a configuration — the shape of a scale (the shape of a foil), and the point which tends to be distributed by homogeneity although it is divided roughly granular and in the shape of a staple fiber and there is especially no limit — the shape of a foil — or — being granular (electrolytic copper powder being included) — it is desirable. Especially grain size is not restricted. The amount of copper powder has 1 - 40 desirable % of the weight to the solid content of a binder. If there are few amounts of copper powder, prevention of the fade phenomenon in an elevated temperature will become difficult, if many [ too ], coefficient of friction will be greatly unstable and a wear rate will also become high. It is 5 - 30 % of the weight more preferably.

[0011] The powder of the organic substance, such as powder of the powder of metals, such as powder of inorganic substances, such as a calcium carbonate with a friction regulator well-known in addition to this, a magnesium carbonate, a barium sulfate, clay, talc, a graphite, an alumina, a mica, fluorite, a zirconia, hematite, magnetite, a silica, an antimony sulfide, an iron sulfide, and a molybdenum sulfide, iron, and lead, cashew dust, rubber dust, and various resin hardened materials, etc. is used.

[0012] As for a binder, phenol resin is used preferably. The reason is that it can make

temperature dependence of a friction property smaller than the case where other thermosetting resin is used by excelling in thermal resistance and an adhesive property, and combining with the melamine dust of a friction regulator, an antimony trioxide, copper powder, etc. in a cheap top. In phenol resin, it has not denaturalized and the thing of a resol mold is more desirable. Moreover, thermosetting resin or cross-linking rubber, such as melamine resin, a urea-resin, polyamidoimide resin, polyimide resin, and an epoxy resin, may be used for extent which does not influence thermal resistance with phenol resin. As for the amount of a binder, it is desirable to make it contain ten to 50% of the weight as solid content in the friction material obtained. If there are few amounts of a binder, the bonding strength of the base material of fibrous material and a friction regulator will become weak. If many [ too ], adjustment of coefficient of friction and a wear rate will become difficult.

[0013] For obtaining friction material, it is based on the following approaches. The admixture which added the friction regulator to the solution of thermosetting resin first, and was mixed is applied or sunk into the fiber base material of the shape of a sheet like a fiberglass mat. [ whether admixture is made to adhere to a fiber base material at homogeneity, it considers as a coating sheet, the post-desiccation which wound up this coating sheet annularly removes a solvent, and a preforming article is obtained, and ]

[Or after considering as the prepreg sheet from which the sheet which carried out coating was dried with the dryer etc., and the solvent was removed, this sheet is cut on tapes, such as the shape of the shape of a roll, and a slit, it winds up annularly, and a preforming article is obtained.] In less than 0.5 times of true density [ like a prepreg sheet ] (desiccation article base) of a sheet-like fiber base material whose apparent density of this preforming article is, since the sheet which the push cost of mold goods was too large, and wound up annularly is confused, burst reinforcement falls. In order to make

apparent density of a preforming article into 0.5 or more times of the true density of a sheet-like fiber base material, in case a coating sheet or a prepreg sheet is twisted annularly, there are approaches, such as twisting using and pulling 3 bolting roll, a planar pressure roll, etc., and applying the force. Thus, it molds by heating under pressure by putting the obtained annular solid into metal mold etc., subsequently mold goods are heat-treated under predetermined heating conditions, and resin is stiffened.

[0014] 35 / 65 - 65/35 have [ the coating weight of the admixture at the time of using a fiberglass mat for a fiber base material ] desirable fiberglass mat/admixture (solid content of a friction regulator + binder) by weight. If there is too much coating weight of admixture, mechanical strength will fall and wear will increase. On the other hand, if there is little coating weight, coefficient of friction will become high and will become unstable. Although there is no limit in the approach of spreading to which admixture is made to adhere, or sinking in, the approach of carrying out immersion sinking in of the fiber base material into admixture, or applying by knife coater has uniform coating weight, and is desirable. There is also no method of removing a solvent and it is made, especially as for a limit, for adhering resin not to harden it.

[0015] [Example] Next, the example of this invention is explained.

[0016] as an example 1 friction regulator -- the powder (the product made from Cashew --) of a melamine resin hardened material the melamine dust H-90448 weight section and an antimony trioxide (the product made from the Wako Pure Chem industry --) Six weight sections for chemistry, the electrolytic copper powder (Nippon Mining make, NO.5-2-D, 44 micrometers or less) 2 weight section, the barium-sulfate (product made from Sakai chemistry, BC) 3 weight section, and a calcium silicate staple fiber (the product made from U.S. NYCO --) A total of 25 weight sections of the trade name wollastonite 3 weight section, the cashew denaturation friction dust (product [ made from Cashew ], WD-1350) 1 weight section, and the carbon black (Tokai Carbon make, C strike 116) 2 weight section were prepared. Furthermore, a total of 3.6 weight sections of the sulfur powder (product made from Hosoi chemistry, fines sulfur) 3 weight section and the zinc-oxide (product made from Wako Pure Chem industry, for chemistry) 0.6

weight section were prepared as a rubber vulcanizing agent, with said friction regulator, it mixed by the V shaped rotary mixer, and mixed powder was created.

[0017] On the other hand, to the resol mold phenol resin (Dainippon Ink & Chemicals make, TD-2040C, 100% of solid content) 15 weight section, and the acrylic nitril swine JIEGOMU (NBR, Nippon Zeon make, Nippol1041) 6.4 weight section, the MEK(methyl ethyl ketone) 61 weight section was added, the mixed dissolution was carried out, and phenol resin / NBR solution was created. Injection mixing of said mixed powder was carried out at this solution, and admixture (slurry) was obtained.

[0018] The 5-% of the weight water solution of polyvinyl alcohol (the product made from the Wako Pure Chem industry: polymerization degree 400, Following PVA and a name) was sunk into 50 weight sections of a fiberglass mat [the product made from the Fuji fiberglass, and FEM 450-5 (the thing and eyes which were obtained from the chopped strand with 100 filament numbers and a strand die length of 50.8mm areg [ 450 ]/m<sup>2</sup>) with a width-of-face [ of 30cm ] x die length of 60m, and PVA was made to adhere to them. It was immersed into said slurry and this sinking-in processing fiberglass mat was used as the sinking-in sheet, and this was dried at the temperature of 60 degrees C with the continuation dryer, and it considered as the sheet for shaping of the prepreg sheet of true-density 2.27 g/cm<sup>3</sup>. Next, this sheet for shaping was cut in the shape of [ of 10mm width of face ] a tape, that die length of about 30m was twisted around the iron cylinder with a bore of 150mm, and the preforming article of the shape of a circular ring with an outer diameter [ of 225mm ] and a thickness of 10mm was obtained. The consistencies of this thing were 1.14 g/cm<sup>3</sup> (0.5 times of the true density of a prepreg sheet).]

Subsequently, metal mold was filled up with this preforming article the whole cylinder, it fabricated at 160 degrees C for 15 minutes with the pressure of 100 kgf/cm<sup>2</sup>, and the Plastic solid with a thickness of 4.5mm was acquired. After grinding both sides of this Plastic solid with the sandur and carrying out to 3.5mm in thickness, at 180 degrees C, it performed at 210 degrees C for 2 hours for 1 hour, 240 degrees C performed postcure in order of 2 hours, and the consistency obtained the friction material of 1.55 g/cm<sup>3</sup>.

[0019] By the same approach as examples 2, 3, and 4 and five examples 1, the consistency (g/cm<sup>3</sup>) obtained the preforming article of 1.36, 1.48, 1.65, and 2.00 (0.6 times, 0.65 times, 0.73 times, and 0.88 times of the true density of a prepreg sheet), interweaving by heating under pressure, polish, and postcure were hereafter performed by the same approach as an example 1, and the consistency (g/cm<sup>3</sup>) obtained the friction material of 1.55, 1.60, 1.68, and 2.05.

[0020] The consistency (g/cm<sup>3</sup>) obtained 0.68 and the preforming article of 0.79 and 1.02 (0.30 times, 0.35 times, and 0.45 times of the true density of a prepreg sheet) by the same approach as the examples 1 and 2 of a comparison, and three examples 1, and the consistency (g/cm<sup>3</sup>) obtained the friction material of 1.55, 1.55, and 1.56 by the same approach as an example 1 hereafter.

[0021] Except having set to 8mm width of face of the tape-like sheet twisted around the cylinder in example of comparison 4 example 1, completely like the example 1, the preforming article of consistency 0.68 g/cm<sup>3</sup> (0.30 times of the true density of a prepreg sheet) was obtained, and the consistency obtained the friction material of 1.2 g/cm<sup>3</sup> by the same approach as an example 1 below.

[0022] Some circular rings of the friction material obtained in the example and the example of a comparison are cut down, and it considers as a test piece, and is JIS about this test piece. It attached and operated to the abrasion tester whenever [ fixed-speed / which is set to D4411 ], and the wear rate in 300 degrees C was measured by holding-down pressure force 5 kgf/cm<sup>2</sup>. Moreover, circular ring-like friction material was attached in the rotation disruptive strength testing machine, it rotated by 2500rpm during 5 minutes at 200 degrees C of ambient temperature, subsequently the number of rotations was raised at the rate of per second 100 rotation, the number of rotations at the time of destruction was measured, and it considered as burst reinforcement. These test results are shown in Table 1. In Table 1, a wear rate is the

value (cm<sup>3</sup>/kgf-m) which hung 10-6 on the numeric value of front Naka.  
 [0023]

[Table 1]

表 1

実施例	摩耗率	バースト強度	比較例	摩耗率	バースト強度
1	2.0	13800	1	8.8	9800
2	2.0	14000	2	7.0	10000
3	1.5	14400	3	6.0	11800
4	1.3	14200	4	6.0	8700
5	1.0	14000			

[0024] It is shown that the friction material of an example has large burst reinforcement compared with the thing of the example of a comparison, and a wear rate is small so that clearly from Table 1.

[0025]

[Effect of the Invention] According to this invention, especially, the burst reinforcement in an elevated temperature is high, and the low friction material of a wear rate can be offered.

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